

Affidavit Before the Federal Communications Commission In the matter of Application of SBC Communications, Inc., Southwestern Bell Telephone Company, and Southwestern Bell Communications Services, Inc., for Provision of In-Region, InterLATA Services in Kansas, CC Docket 97-121 (with Timothy J. Tardiff), on behalf of Southwestern Bell, April, 1997.

Statement in Support of The Southern New England Telephone Company's Proposed Reorganization, on behalf of SNET, March 24, 1997.

Statement of Professor Alfred E. Kahn and Report of Professor Jerome E. Hass on Railroad Revenue Adequacy Standards, analyzing the methods by which the Surface Transportation Board determines whether individual railroads are or are not "revenue adequate," on behalf of the Alliance for Rail Competition, February 1997.

Statement of Alfred E. Kahn on FCC's Proposed Reforms of Carrier Access Charges (re proposed Order in CC Docket No. 96-488), on behalf of the United States Telephone Association, February 14, 1997.

Verified Statement Before the Surface Transportation Board on behalf of the National Industrial Transportation League and the Western Coal Traffic League commenting on the joint statement submitted by the Association of American Railroads, Docket No. 41626, Docket No. 41242, Docket No. 41295, November 27, 1996.

"Joint Marketing, Personnel Separation and Efficient Competition Under the Telecommunications Act of 1996" (with Timothy J. Tardiff), a statement on behalf of U S West commenting on the FCC's NPRM of July 17th, in CC Docket No. 96-149, October 11, 1996.

"Economic Competition in Local Exchange Markets" (with Kenneth Gordon and William E. Taylor), on behalf of Bell Atlantic Company, commenting on a statement by seven economists on the pricing of essential network elements submitted by AT&T in state arbitration proceedings, August 9, 1996.

Declaration Before the Federal Communications Commission In the Matter of Allocation of Costs Associated with Local Exchange Carrier Provision of Video Programming Services, CC Docket No. 96-112, July 19, 1996.

Testimony before the Kansas Corporation Commission commenting on the continuing regulation and deregulation of the telecommunications industry in Kansas with reference to Competition docket HB 2728, on behalf of Southwestern Bell, Docket No. 190,492-U, June 14, 1996.

Declaration before the Federal Communications Commission In the Matter of Implementation of the Local Competition Provisions in the Telecommunications Act of 1996, on behalf of Bell Atlantic (with Timothy J. Tardiff), CC Docket No. 96-98, May 30, 1996.

Testimony before the Public Service Commission of Maryland In Support of the Petition of Bell Atlantic - Maryland, Inc. for Adoption of a Price Cap Form of Alternative Regulation, on behalf of Bell Atlantic - Maryland, February 15, 1996; Rebuttal March 14, 1996; Surrebuttal April 1, 1996.

Testimony before the Public Service Commission of Pennsylvania regarding the Formal Investigation to Examine and Establish Updated Universal Service Principles and Policies for Telecommunications Services, Docket No. I-940035, on behalf of Bell Atlantic - Pennsylvania, Inc., December 7, 1995; Rebuttal, February 14, 1996.

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Rebuttal Testimony before the State of Connecticut Department of Public Utility Control, discussing network unbundling, universal service and apportioning loop costs between telephone and video services, on behalf of the Southern New England Telephone Company, Docket No. 95-06-17, September 20, 1995.

Affidavit In the United States District Court for the Eastern District of Virginia (Alexandria Division) in the matter of United States Telephone Association, et al v. Federal Communications Commission, Civil Action No. 95-533-A, on behalf of USTA (with William E. Taylor), October 24, 1995.

"Preserving Universality of Subscription to Telephone Service in an Increasingly Competitive Industry" (with Timothy J. Tardiff), before the Public Utilities Commission of the State of California, on behalf of Pacific Bell, September 1, 1995.

Rebuttal Testimony before the Commonwealth of Massachusetts Department of Public Utilities, Docket 94-185, discussing network unbundling and universality of service, on behalf of NYNEX, August 23, 1995.

"Alternative Regulation for Connecticut Telecommunications Services," before the Connecticut Department of Public Utility Control, discussing the economic principles that should guide the introduction of an alternative form of regulation for noncompetitive telecommunications services, on behalf of the Southern New England Telephone Company, Docket No. 95-03-01, June 15, 1995.

Rebuttal Testimony before the New Jersey Board of Regulatory Commissioners, in the matter of the Investigation Regarding IntraLATA Toll Service Competition on a Presubscription Basis, Docket No. TX94090388, on behalf of Bell Atlantic - New Jersey, Inc., May 31, 1995.

Testimony before the Connecticut Department of Public Utility Control on strandable investments, on behalf of United Illuminating, Docket 94-12-13, March 24, 1995.

"Rebuttal Evidence on Rate-base Splitting, Price Caps and the Treatment of Economies of Scope in Telecommunications Regulation," submission to Canadian Radio/television and Telecommunications Commission, Ottawa, Ontario, Canada, on behalf of AGT Limited, March 30, 1995.

"Preconditions of Efficiently Competitive Local Exchange Markets," submission to Canadian Radio/television and Telecommunications Commission, Ottawa, Ontario, Canada, on behalf of AGT Limited, March 15, 1995.

Testimony before the Connecticut Department of Public Utility Control, Docket Nos. 94-10-01-02, on incremental cost standards for network unbundling, on behalf of the Southern New England Telephone Company, January 10, 1995; Rebuttal Testimony, February 13, 1995.

"Comments on Competition in Electric Power," submission to Rhode Island Division of Public Utilities and Carriers, inquiry into retail competition in the electric utility industry, on behalf of The Narragansett Electric Company, Docket D-94-9, November 18, 1994.

Testimony before the State of New York Public Service Commission in the Petition of Rochester Telephone Corporation for Approval of Proposed Restructuring Plan (Panel on Public Policy Issues with Robert W. Crandall), Case Nos. 93-C-0033 and 93-C-0103, February 3, 1993; Testimony of Panel on Public Policy Issues in Support of Settlement, June 17, 1994; Rebuttal Testimony of Panel on Public Policy Issues, July 22, 1994.

Affidavit before the Federal Communications Commission In the Matter of Price Cap Performance Review for Local Exchange Carriers, Notice of Proposed Rulemaking, on behalf of Bell Atlantic, filed June 29, 1994.

Affidavit before the U.S. District Court for the Northern District of Alabama Southern Division on behalf of BellSouth Corporation on overturning the statutory prohibition of telephone companies carrying their own video programming, filed June 3, 1994.

Reply Affidavit before the U.S. District Court for the District of Michigan (Eastern Division) on behalf of Ameritech Corporation on overturning the statutory prohibition of telephone companies carrying their own video programming, filed May 16, 1994.

Affidavit before the U.S. District Court for the District of Columbia on behalf of Southwestern Bell in support of request for out-of-region waiver from the interLATA MFJ restrictions (with William E. Taylor), filed May 12, 1994.

Reply Affidavit before the U.S. District Court for the District of Maine on behalf of NYNEX Corporation on overturning the statutory prohibition of telephone companies carrying their own video programming, filed May 6, 1994.

Testimony on behalf of Bell Atlantic-New Jersey in proceeding involving the issue of opening the intraLATA toll market to competition, filed April 7, 1994; Rebuttal Testimony filed April 25, 1994.

Testimony on behalf of Massachusetts Electric Company before the Federal Energy Commission on wholesale wheeling and the problem of stranded investment. FERC Docket No. ER94-129-000, filed March 14, 1994.

Testimony on behalf of The Chesapeake and Potomac Telephone Company of Maryland, Case No. 8584, on the regulatory principles applicable to determining an efficient price for MFS-I's interconnection with C&P's network (with William E. Taylor), filed November 19, 1993; Rebuttal Testimony filed January 10, 1994; Surrebuttal Testimony filed January 24, 1994.

Affidavit to the Federal Communications Commission with respect to Interstate Long Distance Competition and AT&T's Motion for Reclassification as a Nondominant Carrier (with William E. Taylor), filed November 12, 1993.

Affidavit to the High Court of New Zealand on behalf of New Zealand Rail Limited involving wharfage charges by Port Marlborough, September 27, 1993.

Testimony before the Federal Energy Regulatory Commission On Behalf of a Group of Independent Refiner/Shippers on the proposed Revision to Oil Pipeline Regulations under the Energy Policy Act of 1992, Docket No. RM93-11-000, August 12, 1993.

Affidavit to the High Court of New Zealand on behalf of Air New Zealand, Ltd., and others in a proceeding involving landing charges by Wellington International Airport, Ltd., June 25, 1993.

Affidavit before the U.S. District Court for the Eastern District of Virginia in the matter of *The Chesapeake and Potomac Telephone Company of Virginia v. United States of America*, Civil Action No. 92-1751-A, June 5, 1993 and before the Federal Communications Commission *In the Matter of Amendments of Parts 32, 36, 61, 64 and 69 of the Commission's Rules to Establish and Implement Regulatory Procedures for Video Dial Tone Service*, Petition for Rulemaking RM 8221, June 7, 1993.

Testimony before Denver County District Court, Denver, Colorado, on behalf of Metropolitan Denver Water Authority re City of Denver water rates, May 17, 1993.

"Review of Regulatory Framework: Telecom Public Notice CRTC 92-78," on behalf of AGT (Alberta Government Telephone Company), Alberta Canada, April 13, 1993.

"Major Elements of a Competitive Telecommunications Policy," on behalf of AGT (Alberta Government Telephone Company), Alberta, Canada, February 15, 1993

Testimony on behalf of the Municipal Electric Association evaluating the soundness of Ontario Hydro's Demand Side Management program, December 1992.

Affidavit before the Federal Communications Commission *In the Matter of Amendment of the Commission's Rules to Establish New Personal Communications Services*, GEN Docket No. 90-314, ET Docket No. 92-100, November 6, 1992.

Testimony on behalf of New Zealand Telecom in an antitrust proceeding before the High Court of New Zealand involving terms of interconnection with Clear, a competitive provider of local transport, April 27, 1992.

Testimony on behalf of AMR Corporation and American Airlines, Inc., against UAL Corporation, United Airlines, Inc., UAL Acquisition, Inc., Air Wis Services, Inc., and Air Wisconsin, Inc., 91 CIV. 7773 (KMW), analyzing United Airlines' acquisition of Air Wisconsin's 50 O'Hare jet slots, March 2, 1991. Supplemental and Second Supplemental Testimonies, March 10 and 15, 1992.

Testimony before the Illinois Commerce Commission on behalf of Illinois Power Company, Docket No. P91-0001, on certification of a competing natural gas pipeline, February 24, 1992.

Rebuttal Testimony before the Florida Public Service Commission, Tampa Electric Co. Docket No. 910883EI, on electric utility company responsibilities for demand side management, November 20, 1991.

Affidavit before the Federal Communications Commission *In the Matter of Expanded Interconnection Between Local Telephone Facilities*, CC Docket No. 91-141 ENF-87-14, August 5, 1991.

Statement on behalf of United Kingdom of Great Britain and Northern Ireland in US/UK Arbitration Concerning Heathrow Airport User Charges, April 1991. Rebuttal and Surrebuttal Statements, June and July 1991; testimony before the International Court, The Hague, July 1991.

"The Treatment of New Services Under Price Cap Regulation," on behalf of BellSouth, Federal Communications Commission, June 10, 1991.

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Testimony before the Federal Energy Regulatory Commission on behalf of Conoco, Inc. Kaneb Pipeline Operating Partnership, L.P., and Kerr-McGee Refining Corporation (Williams Pipeline), February 4, 1991.

Affidavit to the U.S. District Court for District of Columbia on behalf of Bell Atlantic Corporation in *United States of America v. Western Electric Company, Inc. and American Telephone and Telegraph Company*, re MFJ restrictions on Bell Operating Companies' ability to offer information services, January 8, 1991.

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Testimony on behalf of Central Telephone Company of Florida before the Public Service Commission, June 12, 1990.

Testimony on behalf of Fireman's Fund Insurance Company on Proposition 103 Rate Regulation Hearings, February 5, 1990.

Testimony before Denver County District Court, Denver, Colorado, on behalf of Southgate Water District vs. Denver Water Authority on conduit extension charges, May 25, 1989.

"Efficient Pricing of Congested Airport Facilities," A Report to the Department of Transport, Great Britain, April 1989.

Testimony on behalf of ETSI Pipeline Project v. Burlington Northern Inc., et al, in the United States District Court for the Eastern District of Texas, Beaumont Division, Civil Action No. B-84-979-CA, February 23, 1989.

Reply Verified Statement on behalf of Concerned Shippers, In the Matter of Railroad Cost Recovery Procedures—Productivity Adjustment; Ex Parte No. 290 (Sub-No. 4), January 17, 1989.

Testimony on behalf of California Coalition for Trucking Deregulation before the Public Utilities Commission of the State of California, In the Matter of the Regulation of General Freight Transportation by Truck, Case No. I-88-08-046, October 27, 1988.

Testimony before the Public Service Commission of the State of New York on the application to construct the Empire State gas pipeline, Case No. 88-T-132, October 1988.

Testimony before the Federal Communications Commission on behalf of Bell South on adjustment factor for local exchange companies under rate cap regulation, In the Matter of Policy and Rules Concerning Rates for Dominant Carriers (CC Docket 87-313), July 1988.

Affidavit on behalf of Massachusetts Port Authority in a proceeding on the proposed structure of landing fees for Logan Airport, Boston, U.S. District Court, District of Massachusetts, June 1988.

Affidavit on behalf of Financial Interchange Inc. in an antitrust arbitration proceeding on the legality of jointly set interchange fees of an electronic funds transfer network, April 1988.

Verified Statement before the Interstate Commerce Commission in Coal Trading Corporation, et al. v. Baltimore & Ohio Railroad Company, et al. (Docket No. 38301S) on the computation of rail stand-alone costs, April 1988.

Testimony on behalf of Public Service Electric & Gas Company, New Jersey on the used and useful doctrine in the context of utility performance standards, April 1988.

Testimony on behalf of the U.S. Postal Service on the pricing of Express Mail, March 28, 1988.

Testimony on behalf of Kentucky Industrial Utility Customers Case No. 9934 on the criteria for deciding whether a nuclear plant should be completed, February 8, 1988.

Testimony and Rebuttal Testimony before the Iowa State Utilities Board Department of Commerce on behalf of Northwestern Bell on the regulatory treatment of depreciation reserve deficiencies, October 1987 and November 1987.

Testimony before the State of Connecticut Department of Public Utility Control on behalf of the Connecticut Cable Television Association on regulating cable television rates, November 13, 1987.

Testimony before the Federal Communications Commission on behalf of Bell South In the Matter of Policy and Rules Concerning Rates for Dominant Carriers (CC Docket 87-313) October 1987 and Reply Testimony, November 1987.

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Testimony before the New York State Public Service Commission on behalf of New York Telephone Company on assessing the competitiveness of telecommunications markets, April 1987.

Testimony before the New Jersey Senate Energy and Environment Committee on behalf of Public Service Electric and Gas Company on draft bill, No. 2801, the "Electricity Market Pricing Act of 1986," January 26, 1987.

Testimony before Federal Energy Regulatory Commission on behalf of Interstate Natural Gas Association of America on "Competitive Implications of Natural Gas Pipeline Marketing Affiliates," December 29, 1986.

Testimony before the New York State Public Service Commission on behalf of the Owners Committee on Electric Rates, Inc., on rent-inclusion and submetering, November 19, 1986.

Testimony before the Illinois Commerce Commission on behalf of Commonwealth Edison Company on standard for deciding whether Braidwood Unit 2 should be cancelled, August 4, 1986.

Verified Statement on Standards for Railroad Revenue Adequacy, on Interstate Commerce Commission's Ex Parte No. 393, Sub-No.1, July 1986.

Supplemental Verified Statement before the Interstate Commerce Commission, Docket No. 38783, Omaha Public Power District v. Burlington Northern Railroad Company on behalf of Omaha Public Power District, April 1986.

Statement to Federal Communications Commission on New England Telephone Company's Proposed Interstate Access Tariff Restructure, January 30, 1986.

Testimony before the Public Utilities Commission of the State of Oregon on inverted rate structures on behalf of the Pacific Power & Light company, January 1986.

Rebuttal Testimony before the California Public Utilities Commission on San Onofre nuclear plants on behalf of Southern California Edison Company, January 1986 and En Banc Proceeding, February 1986.

Testimony and rebuttal testimony before the Arizona Corporation Commission on behalf of Arizona Public Service Company on economic and regulatory principles applicable to entry of nuclear plants into rate base, December 1985, March 1986, December 1986 and March 1987.

Testimony before the Corporation Commission of the State of Oklahoma on economic principles applicable to access charges, Cause No. 29321 on behalf of Southwestern Bell Telephone Company, September 1985.

Testimony before the California Public Utilities Commission on regulatory principles applicable to prudence determinations on behalf of Southern California Edison Company, August 1985.

Testimony before the Corporation Commission of the State of Oklahoma on development of intrastate access charges, Cause No. 28309 on behalf of Southwestern Bell Telephone Company, May 1985.

Verified Statement before the Interstate Commerce Commission, Docket No. 38783 on behalf of Omaha Public Power District, on the grouping of captive shippers for purposes of applying a stand-alone cost test of contested rail rates, November 1984.

Testimony before the House Public Policy and Veterans Affairs Committee of the Indiana General Assembly on behalf of the Indiana Telephone Association, October 25, 1984.

Testimony before the Iowa State Commerce Commission, Docket No. INU-84-6, Investigation into competition in communications services and facilities, October 18, 1984.

Testimony and rebuttal testimony on current cash support for construction and the reorientation of regulatory policy before the Maine Public Utilities Commission, in the matter of Central Maine Power Company's proposed increase in rates, Docket No. 84-120, August 1984 and February 1985.

Testimony and rebuttal testimony for Illinois Power Company on rate base treatment of construction work in progress, before Illinois Commerce Commission, Docket No. 84-0480, August 1984 and April 1985.

Verified Statement before the Interstate Commerce Commission, Docket No. 39687, on behalf of Platte River Power Authority, on the proper definition of the cost of capital for purposes of applying a stand-alone cost test of contested rail rates, July 1984.

Verified Statement and Surrebuttal Verified Statement Before the Interstate Commerce Commission, Finance Docket No. 30300 on behalf of the Water Transport Association, in opposition to the application of CSX Corporation to acquire American Commercial Barge Lines, Inc., February 14, 1984 and April 19, 1984.

Direct and rebuttal testimony, Federal Energy Regulatory Commission, Trans Alaska Pipeline System, on behalf of the State of Alaska, Dockets Nos. OR 78-1-014 and OR 78-1-016 (Phase I Remand) November 1, 1983 and December 23, 1983.

Verified Statement, Interstate Commerce Commission, on the stand alone test for rail rates to captive shippers, on behalf of Utility Fuels, Inc., Docket No. 39002, October 3, 1983.

Testimony on telephone rate structures before the Colorado Public Utilities Commission for Mountain States Telephone & Telegraph Company, May 27, 1983; the California Public Utilities Commission, for Pacific Telephone & Telegraph Company, August 18, 1983; the Missouri Public

Service Commission, September 8, 1983; and Texas Public Service Commission, September 19, 1983, for Southwestern Bell Company.

Testimony before the Utility Diversification Committee of the Legislature of the State of New Mexico, September 2, 1982.

Testimony before the Ad Hoc Committee on Utility Diversification, National Association of Regulatory Utility Commissioners, May 6, 1982.

Testimony before Motor Carrier Ratemaking Study Commission, Orlando, Florida, April 2, 1982.

Testimony before the State of Connecticut Department of Public Utility Control on methods of regulating rates for basic television cable service, March 9, 1982.

Testimony before the Committee of Energy and Public Utilities, The General Assembly of the State of Connecticut on regulation of cable television, March 1, 1982.

Testimony before the Public Utilities Commission of the State of California, for Pacific Power & Light Company on methods of allocating aggregate revenue requirements, September 24, 1981.

Verified Statement, Interstate Commerce Commission, Ex Parte No. 347 (Sub-No. 1), "Coal Rate Guidelines-Nationwide," September 1981.

Testimony for the Department of Justice in the U.S. v. Standard Oil Co. (Indiana) et al. Civil Suit 40212, filed July 28, 1964.

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**AN ANALYSIS OF ALTERNATIVE NETWORK ELEMENTS
AVAILABLE TO CLECS**

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Under the Direction of Francis J. Murphy, President
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I. Executive Summary

This paper presents an analysis of the alternative sources of network elements available to the increasing number of Competitive Local Exchange Carriers (CLECs) providing telecommunications services. Since 1996, the number of CLECs has grown by 400%, from 200 to 1000.¹ Today, in most major markets in the United States, as well as in many smaller markets, CLECs are providing telecommunications services with little or no reliance on the network functionality of the Incumbent Local Exchange Carriers (ILECs). CLECs are providing their own switching, transport facilities and local loops. In addition, they are securing Signaling System 7 (SS7), Operations Support System (OSS), and Operator Services and Directory Assistance functionality from non-ILEC sources. In areas where they do not provide their own facilities, they are opting to purchase network elements from wholesale providers rather than ILECs. The information presented in this report demonstrates that CLECs have been and will continue to be able to successfully expand their networks and corresponding customer bases without relying on ILEC-provided network elements.

II. Analysis of Switching Alternatives Available to CLECs

A. CLECs Are Providing Their Own Switching Functionality

Today, in most major markets in the United States, there are many CLECs providing their own switching functionality, rather than purchasing it on an unbundled basis from an ILEC. CLECs are opting to build their own switching networks because it affords them more control, more flexibility, and better planning capability. Self-provisioning also allows CLECs to choose between various technologies and to be knowledgeable at all times about the available capacity of their facilities. The matrices below detail a sample of CLECs that are providing their own switching functionality, the technology and vendors they are using, and the ranking Metropolitan Statistical Areas (MSAs) where their switches are located.² These matrices contain only a sample of the companies that are opting to provide their own facilities, but even this small sample demonstrates that all types of CLECs are providing their own switching capabilities throughout the country -- in both large and small markets.

¹See Attachment A.(Chart presented by Jeff Phillips, Consultant, TeleChoice, Inc. at a 3Coms's Starting Ahead, Staying Ahead Seminar in Boston, Mass. (February 4,1999)).

²For purposes of this analysis, the ranking MSA are those identified by the United States Bureau of Census. See Attachment B (U.S. Bureau of Census, " *State and Metropolitan Area Data Book 1997-1998, (5th Edition) A Statistical Abstract Supplement,*") (April 1998)). There are a total of 254 MSAs, with No. 1 being the largest.

1. Traditional CLECs Are Providing Their Own Switching Functionality

Traditional CLECs are providing their own switching functionality in markets throughout the United States. For purposes of this paper, traditional CLECs are defined as telecommunications service providers that provide local service to end users over a circuit-switched network in a manner similar to the way ILECs provide service. These CLECs are taking advantage of the numerous switching options available from switch vendors specifically catering to the CLEC market. Various types and sizes of switches with a broad range of functions, feature options, and prices are available from an ever-increasing number of switch manufacturers. As Table 1 below demonstrates, traditional CLECs are providing their own switching capability in most major MSAs, as well as in many smaller MSAs.

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
CLEC	TECHNOLOGY/ VENDOR	MSA RANK OF SWITCH LOCATIONS ()= # of switches
21 st Century Telecom Group	Siemens EWSD	3
Allegiance Telecom	Lucent 5ESS AnyMedia, Nortel DMS 500	1 (3 switches), 2, 3, 4, 6, 7, 9(2), 11
AT&T	Lucent 5ESS, Nortel DMS100	1 (11), 2 (3), 3 (6), 4 (6), 5 (2), 6 (5), 7(2), 8(2), 9 (2), 10, 11 (3), 12, 13 (2), 14,15 (2), 16 (2), 17, 18(2), 20(2), 21, 22, 23, 24 (2), 26, 28 (2), 29, 32, 35 (3), 37, 39, 45, 48, 51, 53, 61, 62, 63, 65, 70, 71, 72, 75, 79, 88, 93, 95, 137
Bay Ring Communications	Class 5 Digital Switch	7
Birch Telecom	Lucent 5ESS	18
Business Telecom, Inc.	Lucent 5ESS 2000	11, 30, 37 (2), 44, 52, 79

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
CapRock Communications	DMS-10, DMS 500	10,127
Electric Lightwave, Inc.	Nortel DMS500, Ascend ATM, B-STDX 9000	13, 15, 23, 35, 95, 103
e-Spire	Lucent 5ESS 2000, Newbridge Main Street, Xpress ATM,	4 (2), 11, 12, 21, 24 (2), 28, 33, 34, 48 (2), 52, 53, 57, 62, 80
FirstWorld	Lucent 5ESS, Nortel DMS 500	2 (2), 5
Florida Digital	Nortel DMS500	12
Focal Communications	Nortel DMS 500, AccessNode Express	1 (3), 2, 3 (2), 4, 5, 6 (2), 7, 8
Frontier Communications	Nortel DMS 500,	1 (2), 2, 3, 4 (2), 7 (2), 9, 11, 13, 14, 16, 18, 20, 26
GCI of Alaska (General Communications)	Nortel DMS100, 105, Nortel Remote Sw. Ctr.	141 (3)
GST Telecommunications	Nortel DMS500, AccessNode Express	2 (4), 5 (2), 9, 10, 13,15, 22,55 (4), 56, 62, 64, 95, 103
Hyperion Communications	Lucent 5ESS	1, 6, 36, 38, 48, 65, 66, 71, 72, 75, 93, 107, 168, 198, 217
ICG Telecom	Lucent 5ESS	5, 9, 10, 11, 14, 20 (2), 32, 38, 42, 48, 53, 101
Intermedia Communications, Inc.	Nortel DMS100	1, 2, 3, 4 (3), 6, 7, 9, 11 (2), 12, 14, 16, 18, 21 (2), 23 (2), 29 (2), 30 (2), 33, 38, 43 (3), 44, 47, 53
ITC DeltaCom	Nortel DMS500, Ascend ATM	10 Southern states with 80 POPs.

TABLE 1: SELECTED TRADITIONAL CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
KMC Telecom Corp.	Lucent 5ESS Anymedia	8, 16, 27, 37, 71, 74, 81, 83, 85, 98, 101, 116, 131, 135, 149, 155, 183
Justice Technology	DC0	2
McLeodUSA	Nortel DMS500	29, 109, 171 and one switch in Quincy, IL
MCI WorldCom	various Nortel DMSs, Siemens EWSDs, Lucent 5ESSs.	1 (12), 2 (4), 3 (5), 4 (7), 5 (3), 6 (4), 7 (7), 8(3), 9 (3), 10, 11 (4), 12 (2), 13 (2), 14 (2), 15, 16 (3), 17, 18, 19 (2), 20, 21 (2), 23 (3), 26, 28 (2), 29, 30 (2), 35, 38, 39, 40, 43, 45, 46 (3), 47, 51, 57, 58, 62, 68, 70, 72, 73, 89, 93, 124, 125, 140
MGC Communications	Nortel DMS500	2 (2), 11, 12, 17 (2), 34, 47
New South Communications	Lucent 5ESS AnyMedia	33, 38, 52, 87
Pac-West Telecom	DEX-600E	73
PaeTec	Lucent 5ESS-2000	6, 7, 12, 54, 59
US LEC	Lucent 5ESS AnyMedia	11, 12, 27, 32, 37, 41, 44, 63, 154 (2)
TelePacific	Lucent	2
<i>See Appendix A for table sources.</i>		

CLECs are also providing their own switching facilities in smaller communities throughout the country, not just in the higher ranked MSAs. The table below lists several CLECs that have placed switches in smaller MSAs whose populations are very small compared to the higher ranked MSAs.

TABLE 2: SELECTED CLECs PROVIDING SWITCHES IN SMALL MSAs			
CLEC	SWITCH LOCATION	MSA RANK OF SWITCH LOCATIONS	POPULATION OF MSA
AT&T	Charleston, WV	137	253,850
GCI of Alaska (General Communications)	Anchorage, AK	141 (3 switches)	251,047
Hyperion Communications	State College, PA	217	132,993
	Charlottesville, VA	198	146,617
	South Burlington, VT	168	191,088
KMC Telecom Corp.	Tallahassee, FL	135	260,611
	Topeka, KS	183	164,932
	Fayetteville, NC	131	284,047
	Longview, TX	155	208,250
	Roanoke, VA	149	228,534
McLeodUSA	Cedar Rapids, IA Quincy, IL	171 not in an MSA	181,704 NA
MCI WorldCom	Portland, ME	140	251,438
<i>See Appendix A for table sources.</i>			

2. Cable TV Providers Are Providing Their Own Switching Functionality

Like the traditional CLECs, cable TV (CATV) providers are opting to provide their own switching functionality. In addition to CATV, CATV networks are currently being used to provide both local telephone and Internet services. Unidirectional CATV networks -- which include existing coaxial cable wiring into many homes in America -- are being updated with fiber feeder and electronics that make them two-way systems.³ Once updated, the CATV network provides a high-bandwidth alternative to the ILEC network.

In addition, to complete their network build-outs, CATV companies are purchasing their own switching functionality. Companies like Cablevision, Cox Communications, RCN, MediaOne, and Time Warner Cable have placed switching facilities in major cities across the United States and are offering their customers voice-grade telephony service. For

³CableWeb Systems Website, <http://www.cable-web.com>.

instance, Cox Communications, Inc. currently offers residential telephone service in four markets and plans to expand into the remainder of its eight major markets in the next 18 months. These markets account for more than 80 percent of Cox's 3.4 million customers.⁴ Similarly, according to AT&T Chairman C. Michael Armstrong, AT&T's announced purchase of MediaOne "means that far more American consumers will have a choice in local phone service."⁵ AT&T estimates that with the recent MediaOne purchase, it will have access to over 60% of United States households.⁶ As additional mergers and partnerships are formed between CATV and telephony providers, the number of CATV companies purchasing their own switches can be expected to increase.

Table 3 below provides a sample of CATV companies that have deployed their own switches for purposes of providing voice telephony services.

TABLE 3: SELECTED CATV CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
CLEC	TECHNOLOGY/ VENDOR	MSA RANK OF SWITCH LOCATIONS () = # switches
Cablevision Systems (Lightpath)	Lucent 5ESS	1 (2), 14
Cox Communications	Nortel DMS500	15, 17 (2), 27, 33, 39, 45, 51, 61
MediaOne	Lucent 5ESS	7, 8, 11, 16, 44, 47, 50, 56
RCN	Lucent 5ESS, Nortel DMS250	4, 7
Time-Warner Telecom	Lucent 5ESS	1, 10, 17, 20, 23, 26, 28, 29, 30, 31, 32, 37, 40, 41, 42, 43, 54, 55
<i>See Appendix A for table sources.</i>		

⁴"Telecommunications Competition is Flowing," by Jim Robbins, President and Chief Executive Officer of Cox Communications, Inc., Cox Communications Website, <http://www.cox.com/Corporate/Competition>

⁵AT&T offers \$62 billion in cash, stock and assumed debt and preferred equity for MediaOne Group, (April 22, 1998), <http://www.att.com/press/item/0,1193,439,00.html>.

⁶AT&T Website, <http://www.att.com/press/item/0,1193,439,00.html>.

3. Data CLECs Are Using Emerging Technology Solutions In Place Of ILEC Switching

In addition to traditional CLECs and CATV providers, carriers calling themselves Data or Packet CLECs make up a significant percentage of today's telecommunications market. These companies -- such as Covad Communications Group, NorthPoint Communications, and Rhythms NetConnections -- focus on providing packet-switched, Internet Protocol (IP)-based data services to business customers, rather than local consumer voice service. The Data CLECs, however, are on the leading edge of an important development in the telecommunications industry -- the convergence of existing voice networks with the traditionally separate data/packet networks. This convergence is being driven by burgeoning data communication demands as well as by the constant pressure to reduce networking costs.

A key factor in this convergence is a packetized voice technology commonly known as Voice-over-IP (VoIP). In general terms, VoIP technology allows voice information to be sent in digital form by discrete data packets traversing shared virtual-circuits, rather than by the traditional circuit-committed protocols of the public switched telephone network (PSTN). A current advantage of VoIP is that it avoids the tolls charged by ordinary telephone service providers. To deploy VoIP, an enterprise positions a "VoIP device" (such as Cisco's AS5300 access server with the VoIP feature) at a gateway. The gateway receives packetized voice transmissions from users within the company and routes them to other parts of the company's intranet (local area or wide area network) or, using a T-1 or E-1 interface, sends them over the public switched telephone network. Another significant advantage of VoIP is a reduction in network costs: Because the voice traffic shares the digital pipes that enterprise customers are purchasing to carry their data traffic, voice circuit charges are eliminated.

As these technologies mature and standards for interconnection are established, the all-digital, packet networks will replace the current circuit-switched networks. At the forefront of this convergence, Data CLECs on their own, and in partnerships with Internet Service Providers (ISPs), are beginning to offer VoIP service -- along with data, networking and Internet services -- to their enterprise customers.

Unable or unwilling to simply ignore VoIP, the established telecommunications network providers are also planning for the convergence of their existing voice and data networks. These companies agree that Asynchronous Transfer Mode (ATM) packet switching networks must be built now to support the telecommunications of the future.⁷ AT&T is leading the way in building packet-switched networks. It recently announced that,

⁷Gary Kim, CLECs Toeing OIP Waters, <http://www.soundingboardmag.com/articles/951feat2.html>.

by the end of 1999, it would have local ATM connectivity in 41 cities nationwide.⁸ These packet-switched networks will allow the equivalent of local switch technology to be moved to the end user location, thereby eliminating the need for an ILEC switch. Other existing and new companies are following AT&T's lead: MCI WorldCom, Sprint, Qwest, Level 3, and IXC Communications are all building similar networks.⁹

To meet the demand, many large switch manufacturers are currently developing VoIP and ATM switching equipment. And several companies -- including Qwest, Level 3, ICG Netcom, and IXC Communications -- have already deployed VoIP networks.¹⁰

4. Wireless Providers Are Providing Their Own Switching Functionality

CLECs that provide wireless telecommunications services are also opting to self-provision their own switching functionality to serve customers provisioned over wireless local loops. Table 4 below provides a synopsis of some of the fixed wireless companies that are placing their own switches rather than obtaining the functionality from ILECs or wholesale providers. These companies, who cater primarily to business customers, are providing local service by using 38 Ghz microwave technology to transport traffic from their end users to their switches. Even though Table 4 contains only a small sample of fixed wireless providers, it demonstrates that these CLECs have switching functionality in many of the major MSAs around the country.

⁸Infoworld, www.infoworld.com, March 29, 1999.

⁹Network Computing Online, <http://networkcomputing.com/shared/printArticle?article=nc>.

¹⁰*Id.*

TABLE 4: SELECTED WIRELESS CLECs PROVIDING THEIR OWN SWITCH FACILITIES		
CLEC	TECHNOLOGY/ VENDOR	MSA RANK OF SWITCH LOCATIONS () = # switches
AT&T	Lucent 5ESS, Nortel DMS100	1 (11), 2 (3), 3 (6), 4 (6), 5 (2), 6 (5), 7(2), 8(2), 9 (2), 10, 11 (3), 12, 13 (2), 14,15 (2), 16 (2), 17, 18(2), 20(2), 21, 22, 23, 24 (2), 26, 28 (2), 29, 32, 35 (3), 37, 39, 45, 48, 51, 53, 61, 62, 63, 65, 70, 71, 72, 75, 79, 88, 93, 95, 137
McLeodUSA	Nortel DMS500	29, 109, 171 and one switch in Quincy, IL
NEXTLINK	Nortel DMS 500	1,2,3,6,9,8,12,13,14(2), 95,
Teligent	Nortel DMS	1 (2), 2, 3, 4 (2), 6 (2), 7, 8, 9, 10, 11, 12, 13, 15, 20, 26, 29, 32, 39, 50
WinStar	Lucent 5ESS AnyMedia	1 (2), 2, 3, 4 (3), 5, 6, 7 (2), 8, 9 (2), 11 (2), 12 (2), 13, 14, 15, 16, 17, 18, 20, 26, 31
<i>See Appendix A for table sources.</i>		

5. There Are Advantages To CLECs Providing Their Own Switching

The proliferation of new switching technologies and the emergence of vendors catering to new market entrants make it possible for CLECs and other service providers to expand their networks efficiently without relying on ILECs for switching capabilities. Switch manufacturers are designing switches and integrated switching platforms to meet CLECs' specific telecommunications and market requirements. Today's available switching platforms offer flexible architectures, modular hardware and software options, and multiple access arrangements for a variety of facility media (copper, fiber, or radio) and bandwidth (voice frequency, DS1, ATM, Ethernet, etc.). These switches offer efficient and

scalable growth options for a wide range of line and trunk requirements. Thus, CLECs need only purchase the capacity and functionality they require now, because they can easily and economically grow and expand their product line in the future without service interruptions. This flexibility, coupled with the inter-network compatibility of the available switches, has enabled many CLECs to purchase rather than lease switching facilities. And all of this has led to the growth in the portion of the switch market that specifically caters to CLECs and other alternative network providers.

A description of some of the switching alternatives available today to CLECs and other providers is found below.

a) Traditional Switch Manufacturers

In the past, traditional switch manufacturers catered primarily to the needs of ILECs. There were generally separate development paths for voice, data, and video services. Integration of services frequently was time-consuming, complex, and costly. But this is no longer the case. Traditional switch manufacturers are now courting CLECs, IXC's, CAPs, CATV, and ISPs. They are emphasizing the ability of their product lines and platforms to provide a full range of functions with the rapid, cost-effective introduction of value-added services. They are also touting their switches' scalability and capability to integrate across voice, data, and video networks. Switch manufacturers in this category include Nortel (Northern Telecom), Lucent, and Siemens, to name a few.,

■ **Nortel DMS Systems**

Nortel's DMS-500 is a single, multi-function switching platform for both local and long distance services. It has all the features necessary for competitors to participate fully in the telecommunications market. The DMS-500 is positioned for "emerging service providers" and incorporates both local and long distance capabilities. It can be configured with or without Operator Services functionality.¹¹

- ▶ In its DMS-500 Sponsor Profile at www.clec.com, Nortel states: "The DMS-500 switch uses a modular, scalable design that can meet a wide range of line and trunk size requirements and enables network providers to enter the local/long distance market by deploying an economically sized DMS-500 switch today and adding advanced capabilities later as service needs expand."¹²

¹¹[clec.com, http://www.clec.com/latest/switch98/nortel.cfm](http://www.clec.com/latest/switch98/nortel.cfm)

¹²*Id.*

- ▶ This scalable architecture is supported with a remote product line that ranges from the 6,400 line RSC-S, which can be located up to 650 miles from its host, to the 640-line OPAC, an outdoor unit that can be located up to 100 miles from its host. An additional CLEC alternative for many remote applications is the DMS Access Node, a Next Generation Digital Loop Carrier (NGDLC) device with access to switching functionality.
- ▶ Nortel's small version of the DMS-500 product is the Super Node Size Enhanced (SNSE) model, which accommodates up to 10,000 lines. It can be upgraded to a full DMS-500, with the front-end equipment easily redeployed in another location.
- ▶ The DMS-500 is also being offered to CATV companies entering the phone business, as well as to IXC's and CAP's getting into the local service business.¹³
 - ▶ This switching system offers a hybrid network configuration for fiber and coax that is targeted to cable providers. With the Cornerstone family of access products and applications, the system delivers narrowband and broadband services to homes and businesses. It accommodates both landline and wireless architectures.
 - ▶ The DMS platform can also integrate with Competitive Access Providers' metropolitan fiber-based rings. This allows CAP's to sell a mix of local and long distance services to any size or type of business. The switch has a variety of advanced business features, which can be offered to specific customer locations or packaged for specific industries such as health care.
 - ▶ With the DMS Access Node, a Next Generation Digital Loop Carrier (NGDLC) device, service providers can easily and cost-effectively reach end users and connect them with their switches. Access Nodes can be placed at the customer's location or in collocation space. The Access Node interworks with any vendor's fiber multiplexer. Switch features are available to customers served via the Access Node, providing

¹³See *U.S. Central Office Equipment Market*, (1996); *Northern Business Information* (Jan.1997); *DMS-500 CAP Product/Service Information*, Nortel website, www.nortelnetworks.com.

additional economies of scale. On the low end, "Nortel's versatile Access Node Express is a cost-effective access solution for applications ranging from 24 to 200 lines."¹⁴

- ▶ Nortel also offers the DMS-10 (400 series) product to small service providers with minimum telecommunications requirements. It is a local digital switch that can handle 10,000 to 12,000 lines.

■ **Lucent 5ESS-2000® Family of Switches**

Lucent is targeting this product at CAPs, CATV operators, and IXC's as these companies enter and expand their presence in the local telephone service business, as well as at carriers deploying PCS networks. Evidencing its success in supporting these new markets, Lucent has sold switches to TCG, a competitive access provider, PCS PrimeCo, a wireless service provider, and Time Warner Cable, a CATV operator.¹⁵

- ▶ Lucent's 5ESS AnyMedia Switch™ is marketed as a multi-service, software based switch. It is designed to match the changing requirements of telecommunications service providers. It uses separate modules rather than separate switches for specific service requirements.
- ▶ The product is targeted at the same audience as the Nortel system. The system is completely scalable. It can be introduced in modules, over time, to expand the product for a full mix of voice, data, and video.
- ▶ The 5ESS comes in a variety of sizes, all with full feature functionality.
- ▶ The Very Compact Digital Exchange (VCXD) is the smallest switch configuration of the 5ESS-2000 product line. Lucent states in its product description: "For Service Providers targeting small communities, rural areas and private network locations, the 5ESS-2000 VCDX offers an elegant, cost-effective solution . . . [M]ost of the features available on the 5ESS-2000 are available on the VCDX . . . [T]he VCDX can

¹⁴Nortel Access Node Express Product Portfolio (May 1999).

¹⁵U.S. Central Office Equipment Market (1996); Northern Business Information (Jan 1997).

evolve into various larger configurations utilizing almost all of its existing components.”¹⁶

- ▶ Next in scale is the Compact Digital Exchange (CDX) which can serve up to 37,000 lines. “With the same features and AnyMedia functionality as the larger metropolitan switch, CDX offers you a cost effective method of delivering advanced digital services to customers in rural, suburban, campus, office parks, or other locations.”¹⁷
- ▶ Both the VCDX and CDX can be initially configured for requirements significantly less than their maximum capacities.
- ▶ Remote switching modules extend the service area of the 5ESS-2000 to up to 600 miles from the host. There are a number of remote sizing options that support a wide range of smaller demand applications. The CDX also supports remotes.
- Lucent’s MultiService Module builds a bridge between traditional public switched networks and data networks. It supports Internet access, Internet Telephony services, and other data services. It can easily be integrated into prior purchases in the 5ESS product family.
- The 5ESS has a non-blocking line unit (Express Interface Unit) for data applications. It supports a variety of access methods including Fiber in the Loop, NGDLC, DSLAM, and xDSL.
- **Siemens®**
The EWSD is Siemens’ switching platform for call processing applications. It offers all network applications in a single node via a generic platform, including local, toll, and international gateway functions. It also supports Personal Communication Services. The EWSD is scalable and flexible to meet the varying needs of service providers.
- ▶ Siemens states in its product description, “EWSD offers a flexible and cost-efficient solution to meet all the requirements posed by different

¹⁶5ESS-2000 Switch Product Description, Lucent Technologies Website, www.Lucent.com/netsys/5esswtch.

¹⁷*Id.*

network structures and sizes".¹⁸

- ▶ The EWSD is supported with a line of remote switching products. These offerings include the Remote Control Unit (RCU) with capacities of 300 up to 4300 lines for small central office applications. The RCU can be located up to 600 miles from the host switch. The RCU can be upgraded to the SmartRemote™ discussed below.
- ▶ Siemens' planned SmartRemote™ will support up to 50,000 lines, but can be configured for as few as 1,500 lines. It offers full central office functionality with minimal investment in hardware. It can be used in any application where switching functionality is required. It can serve as a tandem or IXC switch as well. The SmartRemote™ is planned to have a capability of operating up to 3,000 miles from its host (server). This distance capability is based on the CLEC routing Long Distance traffic to an IXC rather than over the umbilical. This is a perfect application for CLECs whose serving market areas are geographically dispersed and have little or no community of interest.
- ▶ The EWSD switching platform is supported with interfaces to provide evolving voice and data services. EWSD PowerNode is a high-capacity platform for all network applications. This includes local, tandem, and toll. It supports evolution from narrowband to broadband services, and from predominantly voice services to mixed voice and data. It allows service providers to build on their existing EWSD investment in network infrastructure.
- ▶ The EWSD supports multiple access arrangements for network efficiency and economies.
- ▶ Siemens also sells the DCO Switching System as a low cost solution for CLECs. This product was originally aimed at RBOCs and Independent Operating Companies to meet service needs in smaller suburban and rural communities.
- ▶ In a press release for the March 1998 Telecom Business '98 Convention and Exposition in Dallas, Texas, Siemens Telecom Networks states the following: "Siemens' DCO switch is ideal for serving suburban and rural areas, and it provides an efficient and

¹⁸Siemens EWSD Product Description Literature, *A Platform for All Call Processing Applications*, Siemens Website, <http://www.siemens.de/ic/networks>.

economical solution for competitive local exchange carriers (CLECs) seeking to enter switched, integrated services markets. Using Advanced Intelligent Network (AIN) features, service providers can offer enhanced customized features such as debit card, international call back and personalized number services.”¹⁹

- ▶ In a similar press release for ALTS '98, Siemens reinforced these same points: “The DCO switch is an ideal system for CLECs entering new markets. Cost effective, competitively priced and fully featured, the DCO switch has one of the largest remote families that support line sizes ranging from 24 to 10,000 lines.”²⁰

All of the above flexibility, coupled with the inter-network compatibility of the switches being marketed, has enabled most, if not all, CLECs to purchase rather than lease switching facilities.

b) New-Breed Switch Manufacturers

There are also companies that are supplying a different type of switching technology to the growing number of telecommunications service providers, including new CLECs and IXC's, as well as wireless and PCS providers. The switches they offer are open and programmable, so that service providers can add functions as they are needed over time. Programmable switches can work with a service provider's current switches and proprietary software, or they can provide transport for new networks. They are often referred to as feature nodes, service nodes, or gateways.²¹

With programmable switches and open interfaces, service providers can roll out new and advanced services more quickly and cost-effectively than with traditional switches. Alliances and partnering arrangements across vendors permit easy integration of functions for voice, data, and video applications. Customers purchase the functions and services they need, and add to them as their markets develop. A description of the features and functions available to CLECs from some of these new-breed switch manufacturers is found below.

¹⁹ *Siemens Telecom Network Demonstrates Competitive Solutions to Telecom Business '98* Siemens Press Release (March 10, 1998).

²⁰ Siemens Press Release, *Siemens Demonstrates Network Solutions at ALTS '98* (Nov. 30, 1998).

²¹ These switches generally do not provide standard Class 5 switching functionality. Instead, they are used to supplement the capabilities of circuit switches.